Wolves, Coyotes, Dogs, and Dingoes: The Evolution and Subspeciation of *Canis lupus*

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This research discusses the evolution of the grey wolf (*Canis lupus)* and its various subspecies. The study seeks to find the time and place at which various subspecies diverged from the main branch of *Canis lupus*. The genetic and archeological history of the golden jackal (*Canis aureus*), coyote (*Canis latrans*), dingo (*Canis lupus dingo*), and domestic dog (*Canis lupus familiaris*) are all examined. There has been fairly extensive research on genetic relations between the different subspecies. Findings of this research show that coyotes (*Canis latrans*) did not diverge from wolves at all, but rather from a common ancestor, *Canis leophagans*, in North America. Golden jackals (*Canis aureus*) also diverged from a common ancestor, albeit a much more distant one. Domestic dogs (*Canis lupus familiaris*) diverged from grey wolves roughly 15,000 years ago in the area of Central-Eastern Europe, while dingoes (*Canis lupus dingo*) diverged from domestic dogs roughly 8,000 years ago. This means that dingoes diverged from domestic dogs before their arrival in Australia, and that the divergence must have taken place while dingoes were still in Southeast Asia.

Keywords: Canidae, Evolution, Speciation

Charge-Separated Excited State Lifetime Modulation by Hole Migration

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Controlling lifetimes of excited states are of key importance in designing photo-voltaic and related devices. A primary mechanism for controlling T1→S0 decay is spin-orbit induced intersystem crossing coupled with long-distance charge separation. This process allows for an adequate reaction time for solar energy conversion or to introduce long-lived emission for various photonic applications. Here we have devised systems which possess two, close-lying excited states, the mixing of which can affect the lifetime. Without changing the spin multiplicity, lifetime modulation is achieved by hole migration between different excited states

Keywords: Donor-Acceptor, Excited State Lifetime Modulation, Hole Migration

Iterative Threshold Decoding of Braided Convolutional Codes

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Modern high-speed digital communications rely on a careful orchestration of information encoding and decoding to ensure low-latency, error-free information transfer. Braided convolutional codes (BCCs), a type of parallel-concatenated turbo code, have been shown to have excellent error-correcting capabilities when decoded using optimal, high-complexity iterative methods. However, such decoding strategies could result in unacceptable power and latency costs. In this work, we employ parallel low-complexity component threshold decoders that greatly reduce decoding complexity and are thus faster, more energy efficient, and easier to implement. Our preliminary results suggest that competitive performance could be achieved with careful choice of the component code and tuning of decoder parameters, providing a path toward future highly efficient codec designs

Keywords: FEC, Telecommunications, Coding Theory

Caffeic Acid Derivatives as a Treatment in Medicinal Anticancer Applications

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As oxidative stress and inflammation are increasingly being contributed to the development of cancerous cells, the study of compounds such as the already employed caffeic acid (CA) become logical next steps. Many modern chemical treatments to the development of cancer cells exhibit highly destructive mechanisms to local healthy cellular growth, as well as to the diseased cells, while new methods are being developed from phytochemicals. At the current state, these phytochemicals are being targeted as potential treatments, as the already published results on CAs has shown a significant promise. Several researchers are currently employing the use of CA with other compounds to emphasize the increase of apoptosis states of effected regions, while minimizing the disruption of native biochemical processes. From the success of the CA mixed reaction, working with derivatives of CA may lead to more effective results in inducing apoptosis without unneeded toxicity. We will be running a variety of caffeic acid derivatives simulations specifically targeting the binding affinity of Cyclooxygenase type-1 (COX-1) and type-2 (COX-2) proteins, as both proteins show contributions to inflammation and carcinogenesis in breast tissue. After this initial phase, the testing will then move onto a treatment of cancer cell cultures. Using isothermal titration calorimetry (ITC) and gel electrophoresis (GE) to test and provide the basis for observing affinities for the derivatives of interest. Through the current hypothesis using these derivatives, we expect to find potential anti-inflammation and anticancer agents.

Keywords: Medicinal Chemistry, Anticancer Agents, Anti-inflammation Agents

Concatenated Spatially Coupled LDPC Codes for Joint Source-Channel Coding

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We investigated a method for joint source-channel coding (JSCC) based on concatenated spatially coupled low-density parity-check (SC-LDPC) codes. A construction consisting of two SC-LDPC codes is proposed: one for source coding and the other for channel coding, with a joint belief propagation-based decoder. Also, a novel windowed decoding (WD) scheme is presented with significantly reduced latency and complexity requirements. Simulation results show a notable performance improvement compared to existing state-of-the-art JSCC schemes based on LDPC codes. Moreover, the asymptotic behavior is analyzed using a protograph-based Extrinsic Information Transfer (EXIT) chart for LDPC block codes with block decoding and also for SC-LDPC codes with the WD scheme.

Keywords: Spatially, LDPC, Joint Source-Channel

Blood Based Lipoarabinomannan Detection in Tuberculosis Patients: Results from a Double-Blinded Clinical Cohort in Uganda

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Almost one-third of the world's population is infected with tuberculosis (TB), the leading cause of death worldwide from single infectious agent ranking above HIV/AIDS. About 10% of those infected have a potential risk to develop active TB at some point in their life. Alarmingly, 40% of TB cases are either not diagnosed, or not notified to TB control programs, highlighting the limitations of current diagnostic platforms, which are either inaccurate or inaccessible. A simple blood-based diagnostic would alleviate this problem, developing which is the goal of our work. Our team has determined that Lipoarabinomannan (LAM), an amphiphilic tuberculosis biomarker, is carried by lipoprotein molecules such as HDL in blood. To detect presence of LAM in blood, we have developed a modified sandwich assay termed lipoprotein capture assay, which utilizes the association of LAM with HDL to achieve rapid biodetection. We have evaluated performance of the Lipoprotein capture assay in a blinded cohort of TB patients from Uganda (n=48), and demonstrate performance in patients presenting with pulmonary and extra-pulmonary variants of the disease. The measurements were made using an ultra-sensitive biosensor platform developed at the Los Alamos National Laboratory. The results indicate the feasibility of developing a simple, blood-based diagnostic for active tuberculosis. In addition, they also indicate the dependence of assay

performance on co-morbidities such as HIV which impact outcomes, thereby providing some valuable information on disease manifestation that can guide the development of intervention strategies.

Keywords: Tuberculosis, Lipoarabinomannan, Diagnostics

SMART Idea? Willingness To Accept Utility Controlled Thermostats During Peak Demand (Preliminary Results)

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Advancements in SMART (specific, measurable, achievable, realistic, and timely) technologies often lacks research into consumer demand and acceptance for these technologies. In this study, we estimate consumer acceptance for a utility-controlled thermostat with a national survey of electric bill payers. We find that 49% of respondents would be willing to allow the electric utility to control their thermostat, and preliminary results show that the average amount of monthly compensation needed for the participation is relatively low, approximately $2.00. We find that demographics such as region, income, and education do not affect participation. However, we find that attitudes and preferences surrounding energy conservation, the electricity provider, and technological solutions to climate change are significant in predicting participation in the program. This suggests that efficient and effective adoption of SMART technologies will depend on consumer targeting by attitudes and preferences as opposed to demographics. This study contributes to the paucity of research on consumer response to SMART technologies by being one of leading studies into consumer preferences and attitudes surrounding utility control for public benefit.

Keywords: Willingness to Accept, Consumer Demand, Contingent Valuation, Consumer Energy, Demand Response

On Generalized LDPC Codes for 5G Ultra Reliable Communication

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Generalized LDPC (GLDPC) codes were first proposed by Tanner, and have many potential advantages. We propose a practical construction of quasi-cyclic (QC) GLDPC codes, where the proportion of generalized constraints is determined by an asymptotic analysis.We analyze quantized finite-precision decoding. The block error rate (BLER) performance of the GLDPC codes, combined with a complementary outer code, is shown to outperform a variety of state-of-the-art code and decoder designs with suitable lengths and rates for the 5G Ultra Reliable Communication (URC) regime.

Keywords: GLDPC, 5G, URC

Powering the Red Planet in Pursuit of Becoming Interplanetary Species

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Microreactors are state-of-the-art reactor concept with power level rated in-between 1 kWe to 10 MWe. Yttrium-Hydride is being considered as primary moderator for microreactor due to its superior hydrogen containment capability compared to other hydrides. However, as all hydrides, yttrium hydride experiences hydrogen dissociation (and thus losses) at elevated temperatures. This loss affects the neutronics of the system due to the availability of less hydrogen, and hence less moderation. Several material property data is missing for yttrium hydride. In the first part of the study, we investigate material data generation from the first principle quantum mechanical simulations. These properties include thermal scattering laws, diffusion coefficients, heat capacities etc. In parallel, advanced multiphysics simulation techniques are developed to further understand the dependence of neutronics and thermomechanics on hydrogen dissociation. The newly created data from quantum mechanics is then implemented in the advanced multiphysics toolset to properly understand how the microreactor evolves over time. Finally, system optimization is applied to generate the ideal reactor candidate for space applications including nuclear electric propulsion and surface power production. This presentation covers material data generation, benchmark, multiphysics toolset creation, and system optimization

Keywords: Nuclear Engineering, Material Science, Mars, Space Nuclear Reactors, Microreactors

Thermodynamics of Taurine Metal-Binding

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Taurine (2-aminoethanesulfonic acid) is an abundant, biologically-relevant amino acid-derivative found in many Eukaryotes. Its potential function as a chelator has not been fully investigated. Chelation is the ability of a molecule to bind metals. Taurine's sulfonic acid chemical group is a possible chelate complex. Using isothermal titration calorimetry, metal-binding of taurine is measured. Determining the chelating abilities of taurine provides information about the potential biochemical roles of taurine, such as preventing metal-catalyzed cell damage or removal of toxic heavy metals.

Keywords: Calorimetry, Chelation, Biochemistry

Studying the Environmental Strategies for Reduction of Occupational Stress of the Employees in the Working Places

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In our modern world, people are constantly facing chronic stress from different sources which some are related to environmental design and urban policy. The author discusses the sources of stress in the contemporary built environment from urban to workstation scale and introduces the intervention strategies for mitigating occupational stress. Due to the importance of this issue, the main question of this research is; what are the main environmental factors in offices that can help the employees experience lower stress lever or help them to reduce the stress after facing it? In other words, occupational stress is the agent and built environment is vector and risk factor of causing disease for employees. Stress affects the efficiency of the work and the health of the employees directly. Moreover, the adverse effects of stress are not only limited to mental health but also those cause diabetes, high pressure, overweight and many other health problems. In this presentation, I am going to discuss how built environment affects a workplace and what kind of intervention in design reduce the stress level in working places on employees. To limit this research, we limited the target population to high stressed employees, since they face chronical stress more than other target population. The result of this research is a better understanding of what are the characteristic responsible working places and milieu that can affect the stress of employees during the day. According to the research, set of effective interventions that might cause lower stress levels in working places will be categorized. This research is based on the cross-disciplinarily systematic literature review of architecture, planning, public health, medical, management and psychological sciences, in the form of Meta-analyze.

Keywords: Environmental Design, Urban Policy, Built Environment

A Comparison of Stable Isotope and Fecal Sample Analyses to Study Diet of a Freshwater Turtle

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Freshwater turtles' dietary habits have been studied using a variety of techniques. Stomach flushing, stomach dissection and fecal collection have been used to gather information about recently consumed prey while the long-term assessment techniques such as stable isotope analysis have been employed to assess diets on a broader spectrum. In this study, we integrated fecal sample analyses with claw carbon and nitrogen stable isotope analyses to assess diets of Rio Grande Cooters (Pseudemys gorzugi) and make a side by side comparison of the two methods. In the fecal samples, we found mainly plants (i.e. Cottonwood, Salt Cedar, Netleaf Hackberry, Willow) and filamentous algae with relatively low percent volume of animal matter (i.e., beetles and insect larvae). Interestingly, stable isotope analyses revealed higher animal intake (i.e., high 13N) in certain classes (i.e., males and females) than previously assumed. Furthermore, based on both nitrogen values and fecal samples, we observed differences in trophic levels in turtles caught at different localities. Therefore, we speculate that different dietary habits may be related to the habitat characteristics. Overall, we conclude that the simultaneous use of stable isotopes and fecal content analyses can provide more detailed information about dietary items as well as aid knowledge regarding species habitat and nutritional requirements.

Keywords: Dietary Habits, Freshwater Turtle, Pseudemys gorzugi, Stable Isotopes, Fecal Contents

Detecting Cyber-Attacks in Smart Grids Using Semi-Supervised Outlier Detection and Deep Feature Extraction

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Smart grids are facing many challenges including cyber-attacks which can cause devastating damages to the grids. Machine learning based approaches has shown to be a promising solution for detecting cyber-attacks in smart grids. However, majority of existing work focused on using supervised learning, which needs representative instances from various attack types to obtain good detection models. In this project, we investigated semi-supervised outlier detection algorithms for this problem which only use instances of normal event for model training. Seven popular semi-supervised outlier detection algorithms were considered in our study including one-class support vector machine (OCSVM), histogram-based outlier score (HBOS), local outlier factor (LOF), cluster based local outlier factor (CBLOF), semi supervised k-nearest-neighbors (k-NN), feature bagging, and isolation forest (iForest). The detection models were trained using the data collected from phasor measurement units (PMUs). Our results show that OCSVM, CBLOF and iForest are the three best algorithms, which also perform better than two popular supervised learning algorithms, SVM and k-NN. We further investigated how feature dimension reduction through feature extraction can improve the detection performance of sem-supervised outlier detection algorithms. We found that nonlinear methods like deep feature extraction with autoencoder can significantly improve the performance while linear methods like principal component analysis (PCA) don't work well.

Keywords: Smart Grid, Cyber-Attacks, Semi-Supervised Outlier Detection, Deep Feature Extraction, Autoencoder.

Water-Fertilizer Coupling Effects on Vegetative Growth of Young Jujube Trees in Semiarid Regions of New Mexico

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Jujube fruits are nutritious, widely consumed in all Asian countries, but relatively unknown to America due to the very limited study of the plant species. Effects of water and fertilizer application on vegetative growth of the jujube trees in semiarid regions have not been investigated. Thus, a field study was conducted in an orchard near the city of Portales, New Mexico, USA. Two-year-old young jujube trees were subjected to one of the combinations of three levels of water: 2 L/plant (W1), 8 L/plant (W2) ,16 L/plant (W3), and three levels of fertilizer: 35 g/plant (F1), 70 g/plant (F2), and 140 g/plant (F3). The increment in stem height (SH), stem diameter (SD), number of leaves (NL), Leaf size (LS), number of shoots (NS), and chlorophyll content (CC) were measured. The data analysis suggested a significant effect of W x F treatment on SH, SD, and NL. Results showed that the combination of high water and mild fertilizer level (W3F2) had the highest increment in SH, SD, and NL. W3F2 treatment increased SH and SD by 60.1 cm and 0.5 cm, respectively. The average number of leaves produced was 674.4 (W3F2). Furthermore, an identical pattern was observed with the interactions of W x F positively effecting leaf CC. Based on this study the recommended combination of water and fertilizer application for jujube growers in the semi-arid region was 16 L and 70 g per plant in order to achieve the optimal growth of young jujube trees. The information provides guidance for scientific management of water and fertilizer in jujube orchards.

Keywords: Jujube, Water-Fertilizer Coupling, Growth

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Experimental Investigation of the Wind Energy Harvesting Potential of a Stand-Alone Piezoelectric Blade

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In recent decades, there has been a growing interest in the harvesting of renewable energy sources on both an industrial scale and on a personal scale. While photovoltaic cells are essentially the agreed-upon means of collecting solar energy for an individual dwelling, no such standard yet exists for the personal collection of wind power. While wind turbines work well for harvesting wind power on large utility-wide scales, there are difficulties involved in deploying the same technology on a consumer scale in urban or suburban environments. These include the lack of steady high-speed winds such as those that exist 80-100 m above the ground in rural areas. One possible solution is to utilize electroactive materials such as a flexible piezoelectric polymer in which aeroelastic flutter is excited by erratic lower velocity winds. The objective of this study is to investigate this possibility in detail. To date, continuing experiments have been conducted on individual samples of polyvinylidene fluoride (PVDF) mounted in an ELD 401 subsonic wind tunnel with a 152.4 mm rectangular test section provided by the Mechanical Engineering Department at the University of New Mexico. Parameters such as length, thickness, width, and shape were varied between samples. Some of the best permutations of these parameters tested so far have produced voltages in hundreds of millivolts.

Keywords: Wind, Energy Harvesting, Piezoelectric, Renewable Energy

Developmental Changes in Resting State and the Association with Neuropsychological Measures

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Resting state activity (assessed by neurophysiological or hemodynamic measures) has the potential to reveal biomarkers for developmental neuropsychiatric disorders. Previous studies have revealed an association between resting state activity and cognition in adults. A common network found during resting state is the frontoparietal network (FPN) which has been associated with cognition. Developmental resting state activity is less well understood, although neural oscillations are known to change with age. The present study aimed to examine resting state activity in the FPN, in children and adolescents, across theta (5-8 Hz) and alpha (9-13 Hz) frequency bands. We hypothesized that older children and those with high attentional skills would have higher parietal alpha activity and frontal theta while at rest. Magnetoencephalography data were collected in 65 children (29 females) ages 9-14 (M=11.73, SD=1.8) years as a part of the Developmental Chronnecto-Genomics (DevCog) study. Resting state data were collected during eyes open (EO) and eyes closed (EC) for five minutes. Participants completed the NIH Toolbox Flanker Inhibitory Control and Attention Test and

Dimensional Change Card Sort Test to assess selective attention. Power spectral density was used to characterize spectral power in the FPN. We found during EO and EC, all participants had higher theta ($F = 27.62$, $p < .001$) and alpha ($F = 27.11$, $p < .001$) power in parietal regions relative to frontal regions. During EC, the high attentional group had higher alpha power ($F = 4.89$, $p = .031$) across the FPN compared to the low attentional group. However, we did not find any associations with age. Thus, the present results demonstrate that developmental changes are gradual in the FPN across the theta and alpha frequency bands. The current findings also suggest that high alpha power at rest may be associated with higher attentional skills in children and adolescents.

Keywords: Magnetoencephalography, Frontoparietal Network, Neurodevelopment, Resting State

Property-Relation Binding: Integrating an Optimized Naming Scheme in ICN-IoT

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The main problems dealing with scalability and interoperability of constraint (IoT) devices stem from the inherent inception of TCP/IP. However, networking under an ICN architecture requires that these devices utilize minimal resources. To realize this, the names that are used to route data is taken into consideration in the paper to scale for IoT devices. In this research I list the current state of the art naming schemes such as (NDN's) Hierarchical. Then I present Property-Relation Binding as a naming scheme for IoT devices that may take on globally unique and fully hierarchical names yet using fewer resources than hierarchical while remaining effectively interoperable. To make the case, I conduct an experiment with different variations.

The results prove that PRB names can perform better than pure hierarchical. By FNV1a hashing the variable number prefixes, followed by performing a shortened number prefix by prefix matching on the full name, the computation time is actually reduced. The mean match time for a Content Store of NDN names to NDN nodes is 8.6 microseconds. Against the same names, the PRB node performs better at matching its CS with an average of 3.5 microseconds. Additionally, for PRB names to PRB nodes, the computation time average is even lower at 2.1 microseconds. The longer variable prefix shows NDN names to PRB nodes at an average of 8.0 microseconds and PRB names to PRB nodes at 6.0 microseconds. For the 20,000 generated hierarchical names, there were no collisions when they were converted to PRB names. For 5kB, 10kB, and 50kB content stores, PRB was able to hold 67, 82 & 82% more names from the 20,000 generated hierarchical names respectively.

Keywords: ICN, NDN, Future Internet Architecture, Naming, IoT

Efficient Device Authentication and Communication Scheme for Smart Grid-Enabled Home Area Networks

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The smart grid-enabled home area network (HAN) connects many devices of a smart home such as smart appliances, renewable energy sources and storage, electric cars etc. to the smart grid to save energy and reduce cost. Since not directly controlled by the Utility, the HAN is the most vulnerable part of the smart grid while device authentication is one of the major challenges for the security of the HAN. In this work, we developed an efficient device authentication and communication scheme for smart grid-enabled HAN utilizing the situation awareness feature of smart home system. The smart home system can detect the current security risk level of the HAN based on information collected from activity recognition and cyber threats. The device authentication and communication protocols are designed based on the security risk levels. A more light-weight protocol is used when the security risk level is low. We developed an example design that considered two levels of security risk. The security of the proposed protocols against various attacks was analyzed. The performance analysis results show that the proposed design can significantly reduce computational and communication cost.

Keywords: Smart Grid, Home Area Network, Device Authentication, Situation Awareness

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Electrochemical Characterization of Oligo(p-phenylene)s for Organic Solar Cells

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Due to the growing demand for “green” and sustainable energy, and the obligation to control greenhouse gas emissions, people have to look for a renewable energy source to reduce emissions of greenhouse gas, such as carbon dioxide. Based on its benefits of no pollution and renewable nature, solar cells have become a highly researched subject in recent years. The conversion efficiency of inorganic solar cells have a limitation around 20%, and silicon solar panels are vulnerable to temperature fluctuations. In addition, because solar cells have a high cost of raw materials, and these materials are difficult to construct into large flexible panels, more attention has been paid to the development of organic solar materials. Organic materials are abundant and easy to process. Thus, organic solar cells are a low-cost technology to harness solar energy. Phenylene-based conjugated oligomers and polymers are promising candidates for organic electronics and solar cells. Several terphenylenes and tetraphenylenes have been synthesized and purified, and 1H-NMR, 13C-NMR, and X-Ray diffraction have already been used to characterize these compounds. To further investigate the properties of these phenylenes, I propose to use cyclic voltammetry to study their electrochemical behaviors, including the number of electrons transferred, and the redox potential. Because cyclic voltammetry is a popular and powerful electrochemical tool to probe reaction involving electron transfer. Particular attention will be paid on the effects of different number of benzene rings and different substituenting groups on the redox behaviors. The completion of this experiment is intended to provide some useful information to further understand of conversion efficiency of organic solar cells, which use the oligo(p-phenylene)s as their materials.

Keywords: Electrochemistry, Organic solar cells, Oligo(p-phenylene)s, Cyclic voltammetry, Phenylene-based conjugated oligomers.

Surface Plasmon Polaritons with Flat Top Profiles

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Surface plasmon polaritons (SPPs), the collective oscillations of conduction electrons in a metal, coupled to electromagnetic fields, have emerged as a promising platform to manipulate light at the nanoscale. These excitations can propagate for hundreds of wavelengths along the interface between a metal and a dielectric, making them ideal for application in photonic interconnnects, ultrasensitive biosensing, and superresolution near-field imaging, to name a few. SPP beams with uniform intensity profiles can serve to advance these applications by enabling new uniform coupling and excitation scenarios not possible with conventional Gaussian profiles. Here, using Hermite-Gaussian modes, which form a complete orthonormal basis for the solutions of Maxwell's Equations for a metal-dielectric interface in the paraxial approximation, we describe and analyze the evolution of the transversal profile shape of SPP beams having flat top intensity profiles over hundreds of wavelengths of propagation. The results of our work serve to advance the fundamental understanding of the propagation of SPP beams with nontrivial profiles and therefore enable new ways of manipulating light below the diffraction limit.

Keywords: Surface Plasmon Polaritons, Flat Top Beams, Metal-Dielectric Interface